REPLACED BY ART 34 AMDT

During lightning strike the small quantities of metals used in these conductors are subject to extreme temperatures and electro-dynamic forces which tend to cause them to ablate. As a consequence, these systems have a "one strike" capability and must be replaced on landing.

A further problem with these conventional technologies is that they require the presence of metal on the radome at all times, irrespective of atmospheric conditions. The conductive properties of this metal can cause serious aberration of radar system radiation patterns, with consequent degradation in the system's performance.

The present invention provides a lightning protection apparatus for a radome comprising;

a source of electrically conducting fluid;

a delivery means for delivering the conducting fluid to the surface of the radome prior to a lightning strike;

a control means for controlling the delivery system; and

means for directing the conducting fluid across the outer surface of the radome thereby providing a conductive channel for the passage of electrical current resulting from a lightning strike and dissipating said current without damage to the radome.

The provision of the electrically conductive medium in a fluid form permits a flexible system whereby the lightning conductive element can be deployed as and when atmospheric conditions are such that there is a significant risk that lightning may strike. The control means monitors the atmospheric condition and initiates delivery of the conductive fluid through the delivery means to the surface of the radome when a change indicative of a high probability lightning strike is detected.

Airflow over the radome surface during flight is sufficient to carry the conductive fluid across the radome surface and direct it towards the airframe thus providing a channel for conducting any current induced by a lightning strike to the airframe for dissipation. When conditions are such that there is no significant danger of lightning strike, the conductive fluid can be removed from the radome surface. When lightning protection is not needed, the conductive fluid can be stored in an insulating container thereby removing the conductive interference from the radar system and any consequent degradation of radar performance.

The control means will generally comprise a series of sensors for detecting changes in the atmosphere associated with imminent lightning. These sensors may detect factors such as changes in light levels, temperature, humidity and the like but most preferably detect changes in electrostatic field strength. Preferably, threshold sensors are also incorporated into the control means for recognising when the field strength has exceeded a predetermined level indicative of a high probability of lightning strike. The control means may additionally incorporate software for controlling the delivery and removal of the fluid. Typically, a predetermined threshold level would be in the region of 1000 volts per metre.

In some circumstances, aircraft are known to accumulate electrostatic charge in the course of flight in relatively stable weather conditions. In these circumstances the polarity of the E-field over the entire surface of the aircraft will be the same (i.e. either directed outward from the surface, or inward towards the surface at all points). In a high probability of lightning strike atmosphere, the polarity of the E-field at the aircraft surface will vary over the surface, being outward in some regions, and inward in others. Thus, in order to better discriminate high probability lightning strike conditions from strong E-fields due to other phenomena, it is preferred that the control means incorporate a means for detecting localised polarity of E-fields at the aircraft surface.

The delivery means itself may comprise any suitable form but conveniently comprises two or more dialectric capillary tubes which vent close to the tip of the radome and a pump and valve arrangement associated with a reservoir of the conducting fluid for pumping fluid into the capillary tubes. The delivery system is conveniently operated by a pneumatic or hydraulic system and should be electrically and spatially isolated from the conducting airframes or anything electrically connected to us, in order to prevent lightning striking the aircraft via a path inside the radome. This may conveniently be achieved by operation via a pneumatic or hydraulic system, employing non-electrically conducting pipes and fluids. Alternatively, the delivery means may be operated by electric pump and valve means powered by a local battery and the control means comprises a signalling circuit of optical fibres.

Where a pump is used to deliver the conductive fluid, the pump may have a reversible action so that the fluid can be withdrawn back into the reservoir when the threat of lightning is removed.

Suitable fluids for use as the conductive fluid include any dielectric carrier loaded with conducting particles. For example distilled water carrying carbon particles. Additives which may optionally be added to improve performance include, wetting agents, anti-blockage agents which separate particles to prevent blockage of delivery tubes and orifices, additives for reducing the evaporation temperature or rate of evaporation of the fluid and anti-static or anti-cling agents to minimise adherence of conductive particles after delivery. Alternative fluids include conductive gases or particulates of conductive material such as mercury vapour or carbon smoke.

In another aspect, the present invention provides a method for conducting lightning across the surface of a non-conducting article comprising;

providing a source of electrically conducting fluid;

delivering the conducting fluid to the surface of the article prior to a lightning strike; and

directing the conducting fluid across the outer surface of the article thereby providing a conductive channel for the passage of electrical current resulting from a lightning strike and dissipating said current through a conductive medium.

For the purposes of exemplification, some embodiments of the invention will now be described with reference to the Figures in which:

Figure 1 shows a schematic flow chart of one embodiment of the inventive system.

Figure 2 illustrates a pneumatically operated embodiment of the invention.
Figure 3 illustrates an electrically operated embodiment of the invention.

Figure 4 illustrates the control system for the embodiment of Figure 2.

Figure 5 illustrates the control system for the embodiment of Figure 3.

As can be seen from Figure 1, a system of electrostatic sensors indicated generally by reference numeral 1 provide input to a control system 2 which comprises a threshold sensor and a simple logic circuit. When the logic circuit detects conditions indicative of a high probability of lightning strike, it communicates this to the pump 4 and valves 3 of the delivery system 7, 8. Conducting fluid from a reservoir 5 is transported through valve means 3 and pump 4 to a system of capillary tubes 7 which vent at various points near the tip of the radome. On deployment of the conducting fluid, as the aircraft is in flight, airflow drags the delivered conducting fluid in a direction opposing the direction of travel of the aircraft across the radome surface and towards the metal airframe.